Integrated Voice Memory

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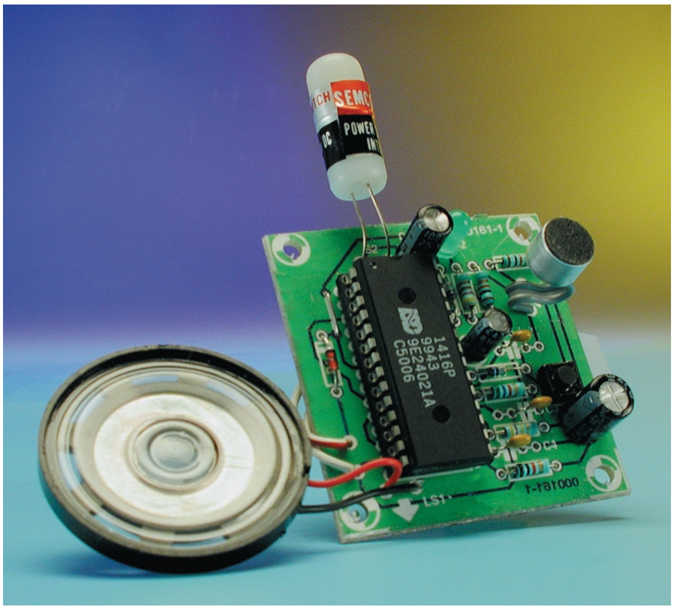

Features of the ISD1416

- High quality recording and playback
- 16 s recording time
- Edge- or level-sensitive playback control, allowing push button operation
- Automatic power down
- Power down current consumption about 1 µA
- Non-volatile memory
- Memory retention: typically 100 years
- Typical life: 100,000 record cycles
- On-chip clock generation
- Operating voltage: 4.5 V to 6.5 V

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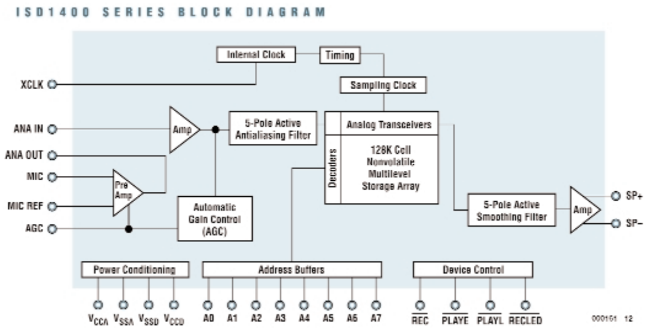

There are lots of exciting applications for a voice memory. The circuit presented here has been installed in the author's toilet in order to advise potential users of the facilities to do so sitting down rather than standing! A mercury tilt switch detects when the seat is lifted and activates the (remotely connected) voice memory: the admonitory text can be chosen at the whim of the householder.

At the heart of the circuit is a voice memory device from ISD (Integrated Storage Devices, now part of Winbond), which is also used in various answering machines and clocks made by Braun. The data sheet is in three parts (...1400_1.pdf, 1400_2.pdf, 1400_3.pdf) and can be downloaded from the Winbond website at http://www.winbond-usa.com/products/isd_products/chipcorder/datasheets/1400/1400_1.pdf

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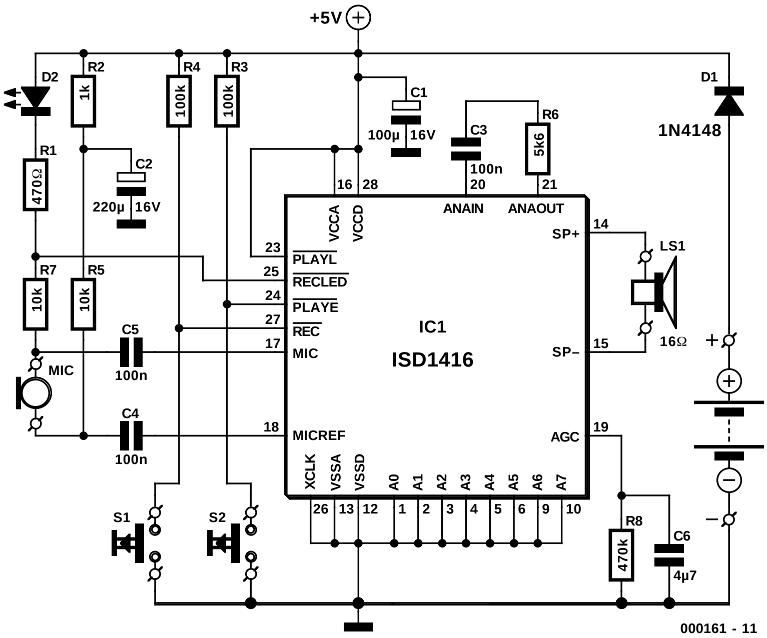

The block diagram in **Figure 1** shows that the ISD1416 contains all the electronics required to record and play back speech or music. Even a practically independent microphone preamplifier with differential inputs is provided. An automatic gain control (AGC) prevents the circuit from being overdriven. The time constant of the AGC circuit is set by R8 and C6. The amplified microphone signal is filtered externally by C3 and R6 and then passes through a line-level amplifier and five-pole anti-aliasing filter before being sampled at 8 kHz. The timing of the A/D converter is governed here by an internal clock: an external clock can also be used.

The samples are stored in a 128 k non-volatile EEPROM array, which makes for a maximum recording time of 16 s. Winbond offers voice memories with recording times

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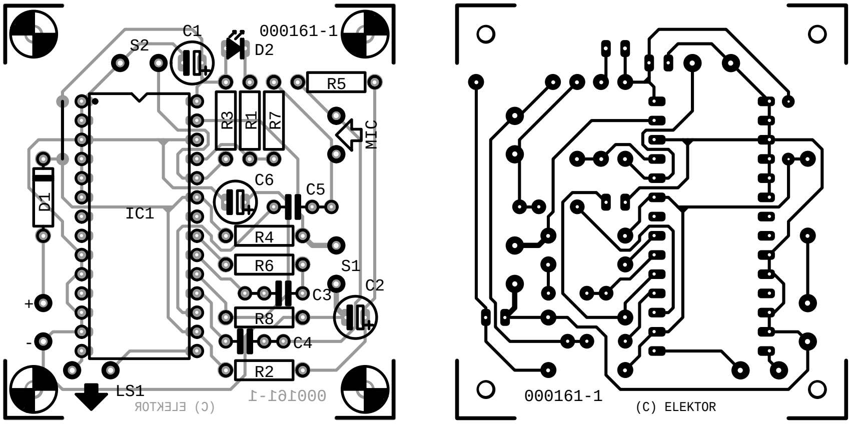

COMPONENTS LIST

Resistors:
R1 = 470Ω
R2 = 100kΩ
R3,R4 = 100kΩ
R5,R7 = 10kΩ
R6 = 5kΩ6
R8 = 470kΩ

Capacitors:
C1 = 100µF 16V radial
C2 = 220µF 16V radial
C3,C4,C5 = 100nF
C6 = 4µF7 16V radial

Semiconductors:
D1 = 1N4148
D2 = LED, high efficiency
IC1 = ISD1416 (Conrad Electronics #164984)

Miscellaneous:
S1 = pushbutton with make contact
S2 = pushbutton with make contact or tilt switch (Conrad Electronics #700444) or photodiode (BPW34)
Mi1 = electret (condenser) microphone (Conrad Electronics #302155)
PC1,PC2 = solder pin
LS1 = loudspeaker 16Ω

of up to 2 minutes. It is interesting to note that the samples are not stored digitally, but in quasi-analogue form with one of 256 different levels in each memory cell. This gives a considerably higher storage density than is possible with conventional digital storage technology, as well as guaranteeing a high quality recording.

The EEPROM array need not be written all in one go: several messages can be recorded and played back independently. Inputs A0-A7 are used to configure the device and to address the memory.

The IC has four control connections: an edge-sensitive and a level-sensitive playback input, a record input and an output which is pulled low during recording. This output activates the microphone and lights a LED. An active five-pole smoothing filter is used during playback, connected to an output amplifier with symmetrical outputs. As can be seen from a glance at the circuit of **Figure 2**, a 16 Ω loudspeaker can be connected directly to these outputs. The quality of this loudspeaker is largely responsible for the final quality of playback. The external circuitry required for the ISD1416 is minimal. The electret microphone is connected symmetrically via two coupling capacitors and only activated in recording mode, when the RECLED connection is low. Only then does the LED light.

The record input is connected to a push button, while the playback input can be connected to a (tilt-) switch, a push button or a photodiode. The edge-sensitive playback input is used, and so once under way, playback will not stop. The photodiode (type BPW34) can be fitted in parallel with or instead of a switch or push button. It could be fitted at the middle of a target: when a laser pointer is fired at the sensor, the marksman is greeted with applause or adulation. The applications are endless.

The small circuit can be constructed on the printed circuit board shown in **Figure 3** (not available from Readers' Services). The layout and component mounting plan can be obtained from the downloads area of the *Elektor Electronics* website under ref**. 000161-1**. The circuit is also sufficiently simple that construction on perforated board (Veroboard) is perfectly possible.

Current consumption during playback is around 25 mA. After playback the IC goes into a power down mode, in which the circuit draws only 90 µA. The two lithium cells (type CR2032) used as the power supply should therefore last for a long time.

(000161-1)